MANPRINT Technologies

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AMC -- Your Readiness Command . . . Serving Soldiers Proudly!

MANPRINT

INTEGRATION OF:

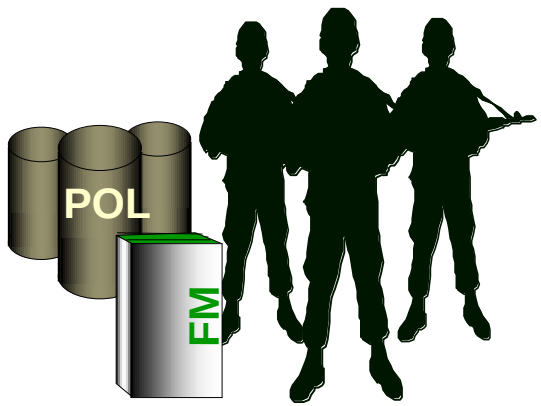
Manpower -- Personnel -- Training
Human Engineering -- System Safety -- Health Hazards
-- Soldier Survivability --

Influence design and fielding to improve battlefield effectiveness (and reduce O&S costs) through consideration of Soldier Performance

The Soldier is a/the Critical System Component!

Soldier-System Task Performance impacts Force Effectiveness

The Soldier is part of a force



Can this soldier, as part of this unit, with this training, perform these tasks, using this equipment?

What Does MANPRINT modeling Do?

It helps...

- ✔ **Set realistic system requirements**
- ✔ **Identify future manpower & personnel constraints**
- ✔ **Evaluate operator & crew workload**
- ✔ **Test alternate system-crew function allocations**
- ✔ **Assess required maintenance manhours**
- ✔ **Assess performance under extreme conditions**
- ✔ **Examine performance as a function of personnel characteristics, training frequency & recency**
- ✔ **Examine and compare skill requirements for jobs**
- ✔ **Examine perceptual and cognitive task demands**
- ✔ **Evaluate fit, field of view and other man-machine interactions for <u>all</u> soldiers (5th to 95th percentile)**
- ✔ **Evaluate clothing and personal item interactions with systems**

Unique MANPRINT Issues in the FCS

New equipment + new organization = new soldier-system design & new manning & personnel issues

- ✔ **Multiple simultaneous analyses required to address System-of-Systems issues**
- ✔ **Human factors modeling**
  - ✓ soldier-system fit & function ➡ Jack
  - ✓ soldier task performance ➡ IMPRINT (Improved Performance Research Integration Tool)
  - ✓ manning & personnel roll-up ➡ IMPRINT (Improved Performance Research Integration Tool)
  - ✓ extreme conditions ➡ IMPRINT (Improved Performance Research Integration Tool)
  - ✓ link to soldier life-cycle cost ➡ AMCOS (Army Manpower Cost System)

Past Accomplishments

- Air Warrior
- “Fox” NBC Reconnaissance Vehicle
- I-BCT Modeling Demo
- Lessons Learned

Air Warrior

Focus on aviator needs

Air Warrior program by its nature is intensively involved with MANPRINT considerations

Mission	Unit and Location	Aircraft	Pilots	Crew
Baseline	Md National Guard Edgewood, MD	UH-1 and OH-58	1	
Extreme Cold	4th 123rd Ft Wainwright, AK	CH-47 UH-60 UH-1	3 2	4 8 1 (medic)
Temperate	101st Ft Campbell, KY	CH-47 UH-60 AH-64	2 3 12	2
	227th Ft. Hood, TX	UH-60 AH-64	7 4	
	110th Ft. Hood, TX	OH-58D	4	
SOAR	160th Ft. Campbell, KY	MH-47 MH-60 AH-6	2 2 3	2 2
Over Water	U. S. Coast Guard Cape May, NJ	HH-65A	2	1 engineer 1 rescue swimmer
Totals			47	21

Project Support
* Joint government and contractor MANPRINT IPT

Representation on:

Input to:

IPTs

Program Documents

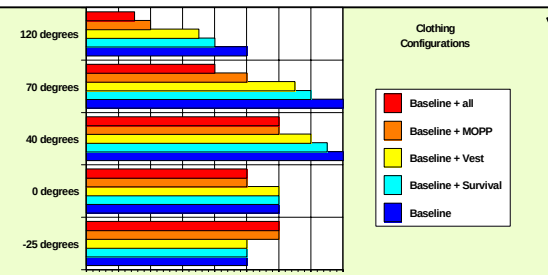
Tech Base Support
Past Studies:
- **ARI**
- **USAARL**
- **AFDD**

Ongoing:
- **ARL-HRED**

Defined limitations on performance with current ensembles

Developing models to support decisions on selection of new promising components

Complete Program Support



Performance Modeling

Video Tracking Technology and Human Figure Model

NBC Reconnaissance Story

Goals of "FOX" Recon System:

- ✔ Reduce crew from 4 to 3 soldiers
- ✔ Use Army maintainers & supplies
- ✔ Add stand-off chemical detection capability (5 km range)

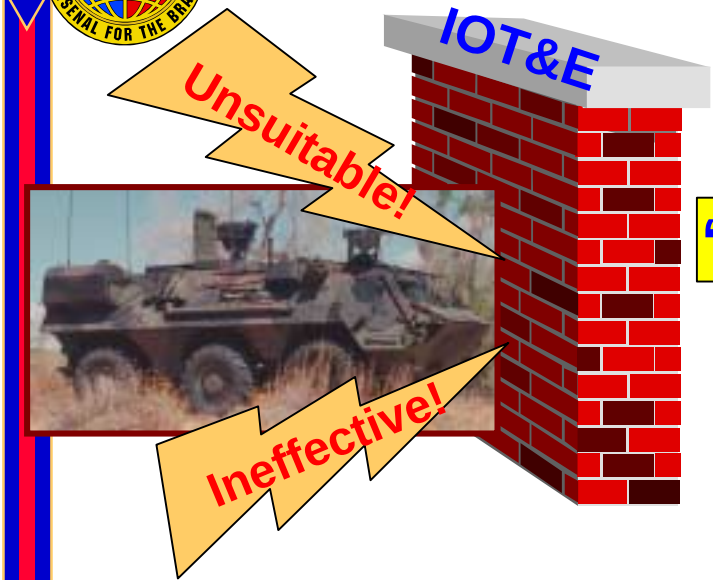
The Problem:

- ✔ 3-person crew rated "unsuitable" & "ineffective" by operational evaluators
- ✔ Dollars to re-design + dollars to re-test exceeded dollars remaining

The Solution:

- ✔ Base system design on:
  - ✚ Human figure modeling
  - ✚ Task-based mission modeling
- ✔ Test to verify model

MANPRINT Modeling Critical to M93A1 Success!



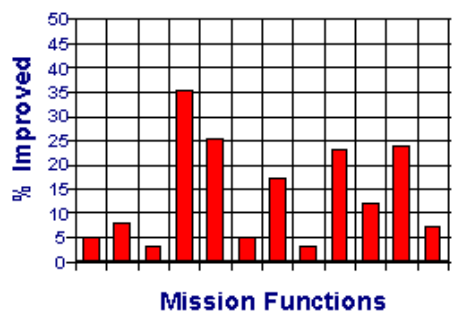
"Fix"

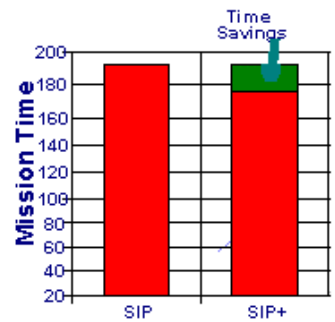
ARL Recommendation:

- ✔ Base M93A1 NBCRS design on;
  - ✚ Human Figure Modeling
  - ✚ Mission-Based Performance Modeling
- ✔ Conduct test to verify model

- MANPRINT Modeling Effort Cost = $60 K
- Schedule Impact = 4 months

- Layout Re-design Optimized Crew Performance
- Model Predicted "Effective" Mission Performance
- OPTEC Test Verified Prediction



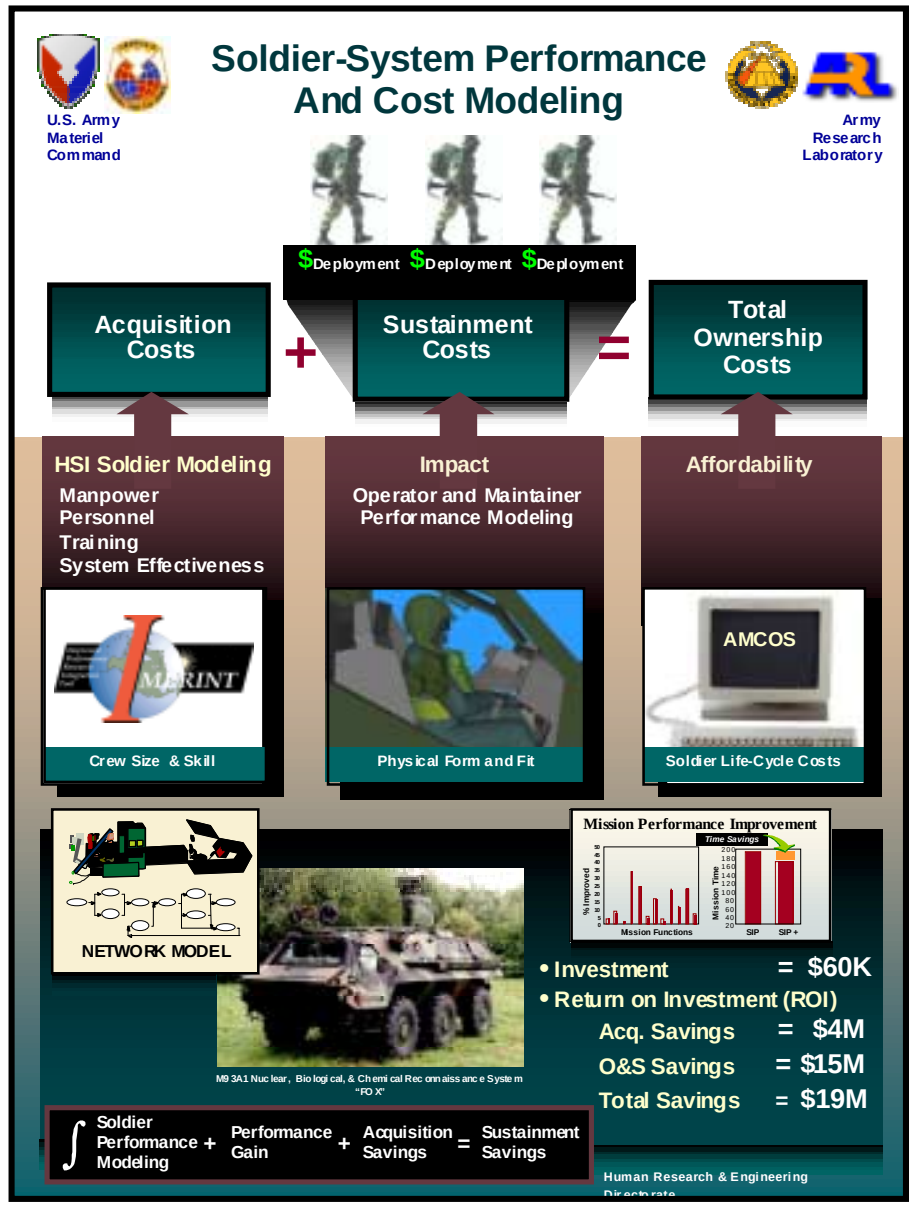


'FOX'
Mission Model Approved
Jan 98
CG OPTEC

Direct Return on Investment = $2-4 M
Indirect ROI (reduced crew, training, etc.) = $1.5 M/vehicle
Total ROI resulting from ARL Support = $137.5 M
OPTEC Accredited Model Support for Block II!

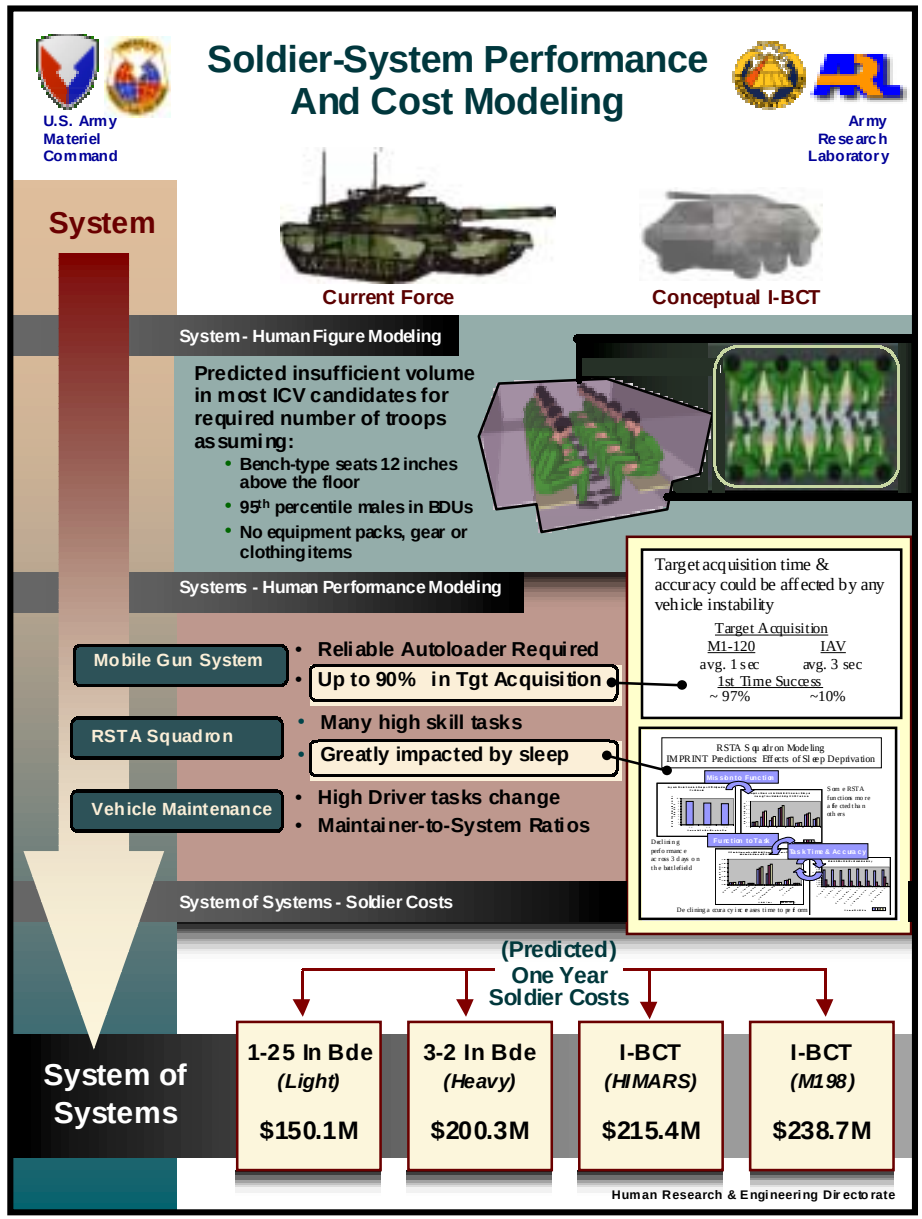
I-BCT Modeling Demo

- ✔ **First cut mapping Ord & O&O to HF issues**
  - ✚ By ARL-HRED using HF and system expertise
  - ✚ IAV acquisition issues vs. new Bde
- ✔ **Identify needed data vs. available data**
  - ✚ Data are “moving target” with rapid acquisition, e.g., TOE, RSTA operations, standard scenario, detailed maintenance data
  - ✚ While data are being obtained, historical and SME data stand-in



I-BCT Modeling Demo

- ✔ **A means of gathering insight into**
  - ✚ system design & soldier performance
  - ✚ manning and personnel issues across systems of systems
  - ✚ soldier-system performance under extreme conditions
- ✔ **A means to link soldier performance, manning, & personnel to lifecycle cost**



Lessons Learned

User and Developer Commitment to the Soldier as the Critical System Component:

- Reduces Risk
- Saves Acquisition Time and Funds

Require the contractor to use:

- Integrated Product Teams with MANPRINT or HSI Representation
- Up-front input from the MANPRINT domains
- Continuous evaluation; Interactive feedback loops
- Modeling Tools
  - **Transom Jack-- anthropometric human figure model**
  - **IMPRINT-- a soldier workload and MPT trade-off tool**
  - **Rapid Prototypes**

Work in Progress

- Soldier Focused Research for FCS
- Effect of Vehicle Movement on Squad Performance
- Indirect Vision Driving
- Crew Integration and Automation Testbed ATD

Soldier Focused Research for FCS

Provide the advanced MANPRINT tools needed for the Army transformation by maximizing the soldier's contribution to mission success.

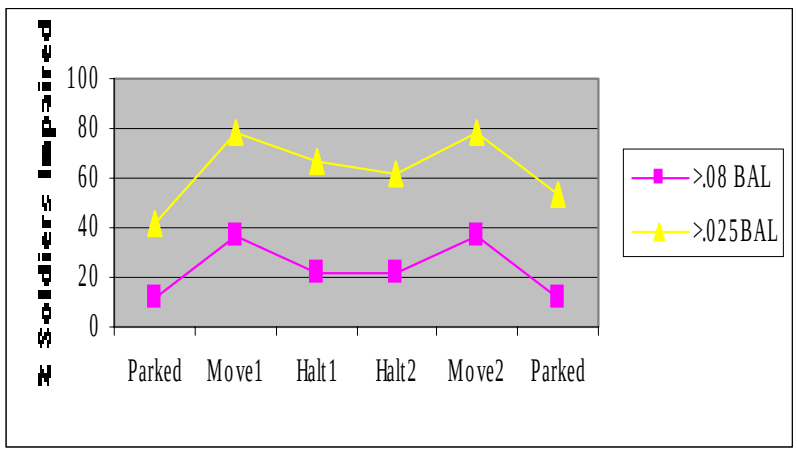
- Model the soldier's contribution to complex systems-of-systems and unit performance.
- Evaluate soldier performance under all conditions (heat, fatigue, workload, stress, etc.) and all missions.
- Reduce time needed to model systems from months to days.
- Ensure soldiers can achieve full FCS potential
- Evaluate tool usability, utility and MANPRINT contribution to system performance and cost.

"*Without highly skilled, competent, and dedicated people, it does not matter how lethal our weapons are or how strategically responsive our formations are because the Army is people…*" The Army Vision, Feb 2000

Effect of Vehicle Movement on Squad Performance

Vehicle Movement

- Induces a broad range of cognitive performance decrements.
- Symptoms persist more than 24 hours in 9.5% of victims
- Physical impairments include discoordination, dizziness, headache, sore neck and extremities, indigestion, and backache.

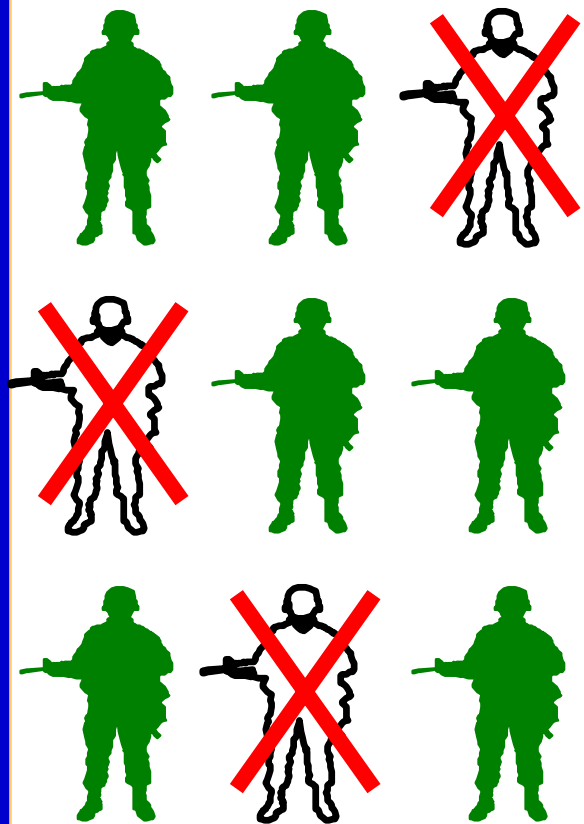


Performance scores are shown as the degradation equivalent to 0.08 and 0.025 Blood Alcohol Level (BAL)

Command and Control Vehicle

- Produced Moderate to Severe Symptoms (Drowsiness, Headache, Nausea, Vomiting) in 55% of soldiers.
- Performance decrement was equal to alcohol impairment in 37% of subjects during movement and 20% of soldiers during short halts

Effect of Vehicle Movement on Squad Performance



The first minutes out of the vehicle are the most critical.

- Situational Awareness
- Mobility
- Target Identification and Acquisition

Over one-third of the force may be ineffective on leaving the IFV

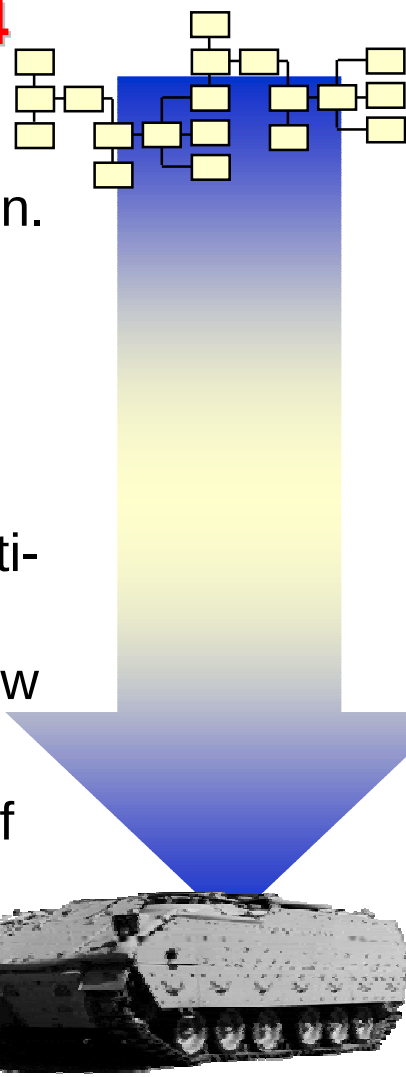
Indirect Vision Driving

- Study conducted in Spring 1999 at APG examined display field of view (FOV) - 110 degrees - compared to 3 camera FOVs: 150, 205, 257
- Crew performance was optimized when camera field of view was closest to the display visual angle
- Indirect Vision Driving increased symptoms of motion sickness and increased mental workload
  - Disabling Motion Sickness was experienced by 2 out of 10 participants due to altered visual cues
  - Some degree of Motion Sickness was experienced by 7 out of 10 participants
- Wider FOVs reduced speed and increased errors
- Developed preliminary model of driver performance as a function of display FOV for use in future design assessments

Results briefed to TARDEC in Aug 1999
Report finalized in March 2000
Display recommendations transitioned to the CAT ATD

Crew integration Automation Testbed Advanced Tech Demo (CAT ATD)

ARL HRED CAT ATD Deliverables FY00-04



- ✔FY00 – Develop task and workload models to target areas of opportunity for CAT ATD crew size reduction.
- ✔FY01 – Integrate modeling results with Vetronics Technology Testbed FY00 findings to form baseline CAT ATD crew station designs.
- ✔FY02 – Select and tailor route planning, cognitive decision aids, DEMO III driving automation, and multi-modal information presentation technologies (e.g. speech recognition, 3D audio, etc.) for CAT ATD crew stations.
- ✔FY03 – Support TARDEC in planning and conduct of CAT ATD technology tests and demonstrations.
- ✔FY04 – Support TARDEC in conduct of CAT ATD warfighter experiments.

Summary

- ✔ **Early MANPRINT application can significantly impact system and unit performance and cost.**
- ✔ **Modeling tools and data are available NOW to address many soldier-system issues.**
  - ✔ Transom Jack (Human Figure) commercially available. (9 applications to systems just from HRED)
  - ✔ IMPRINT (Task Workload) widely available. (Library of 25 applications, including selected IBCT functions)